Electromagnetic Education: Is There a Magic Bullet to Fix the Crisis?

Raj Mittra

EMC Lab, The Pennsylvania State University, 319 EE East, University Park, PA 16802, USA

Abstract— It is no secret that EM education is facing a crisis of sorts, at least in the *developed* countries. Unfortunately, while there is a lot of talk, and a plethora of ideas for solving the problem, there does not appear to be a magic bullet to ‘fix’ the crisis.

In this presentation, we will propose two possible approaches to addressing the problems we face in recruiting undergraduates, and in training graduate students at the Ph.D. level. Not unexpectedly, the two recipes we propose are very different from each other, because they are separately tailored for undergraduate and graduate students, respectively. Though they are not magic bullets by any stretch of our imagination, they are nonetheless time-tested ideas that are worth our consideration, as we grasp for ways to mitigate the EM education problem at hand.

We will begin the presentation by describing a program, which has been in existence at the Penn State University for quite some time now, and which is geared toward attracting undergraduate students in science and engineering to “space science” and related fields. The program works with a selected group of undergraduate students and gives them an opportunity to have a hands-on experience in designing ‘real’ rockets that are launched in space with the help of NASA, which partially sponsors the project at Penn State, as well as at other institutions.

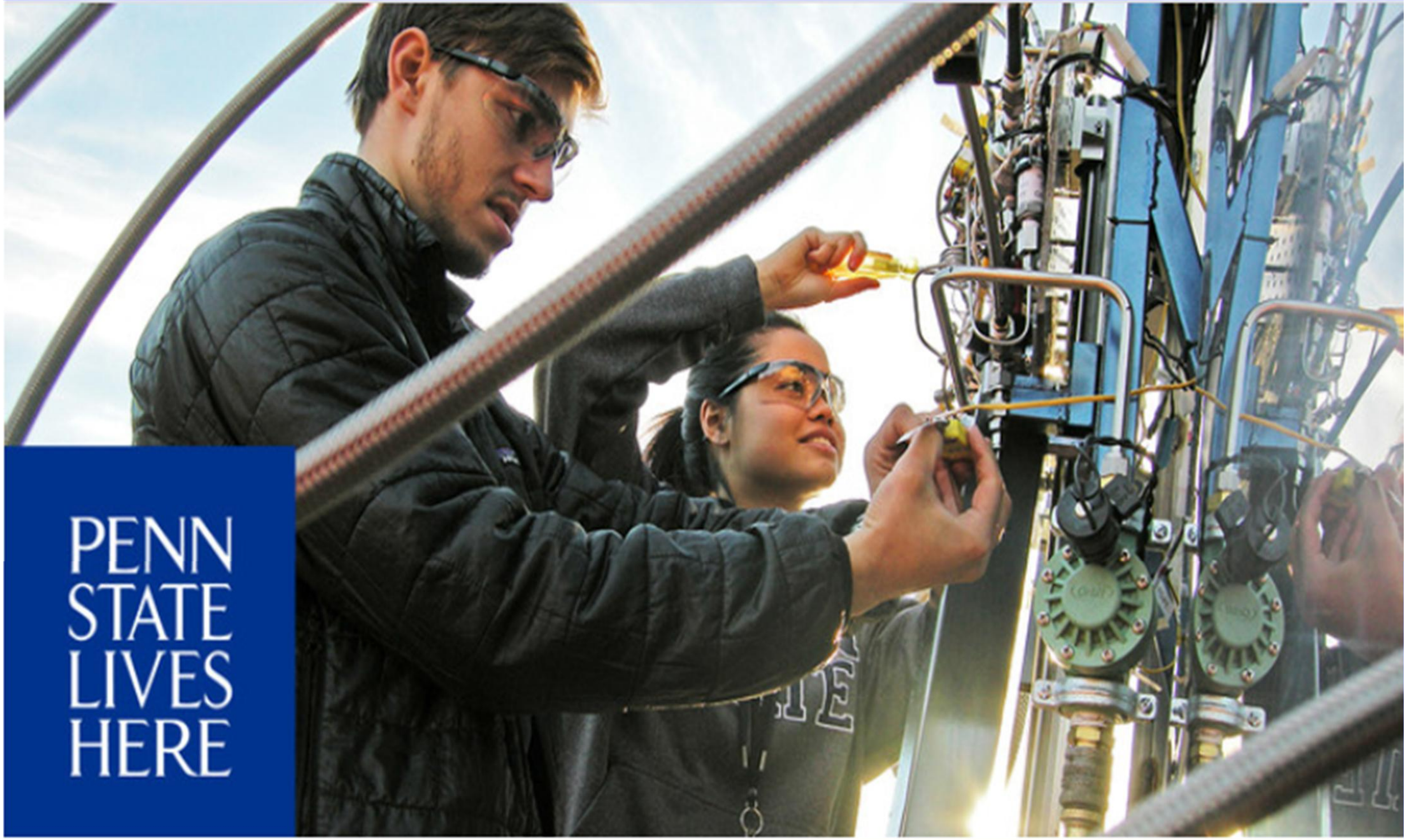
The second strategy, which deals with the issue of training graduate-level students, is more conceptual in nature, and is in contrast to the hands-on experience type of program described above, for the undergraduate students. It teaches the graduate students how to handle the information they gather from the existing literature by examining the material critically, rather than simply accepting this information on blind faith, as they often have a tendency to do, especially when dealing with emerging fields. It also teaches the graduate students how to connect the material which they have learned in their classes to practical real-world problems, of the type they would be expected to tackle when they enter the job market following their graduation.

PENNSTATE

1855

PENN STATE Undergrad Rocket Program

We're Going to the Moon!


PENN
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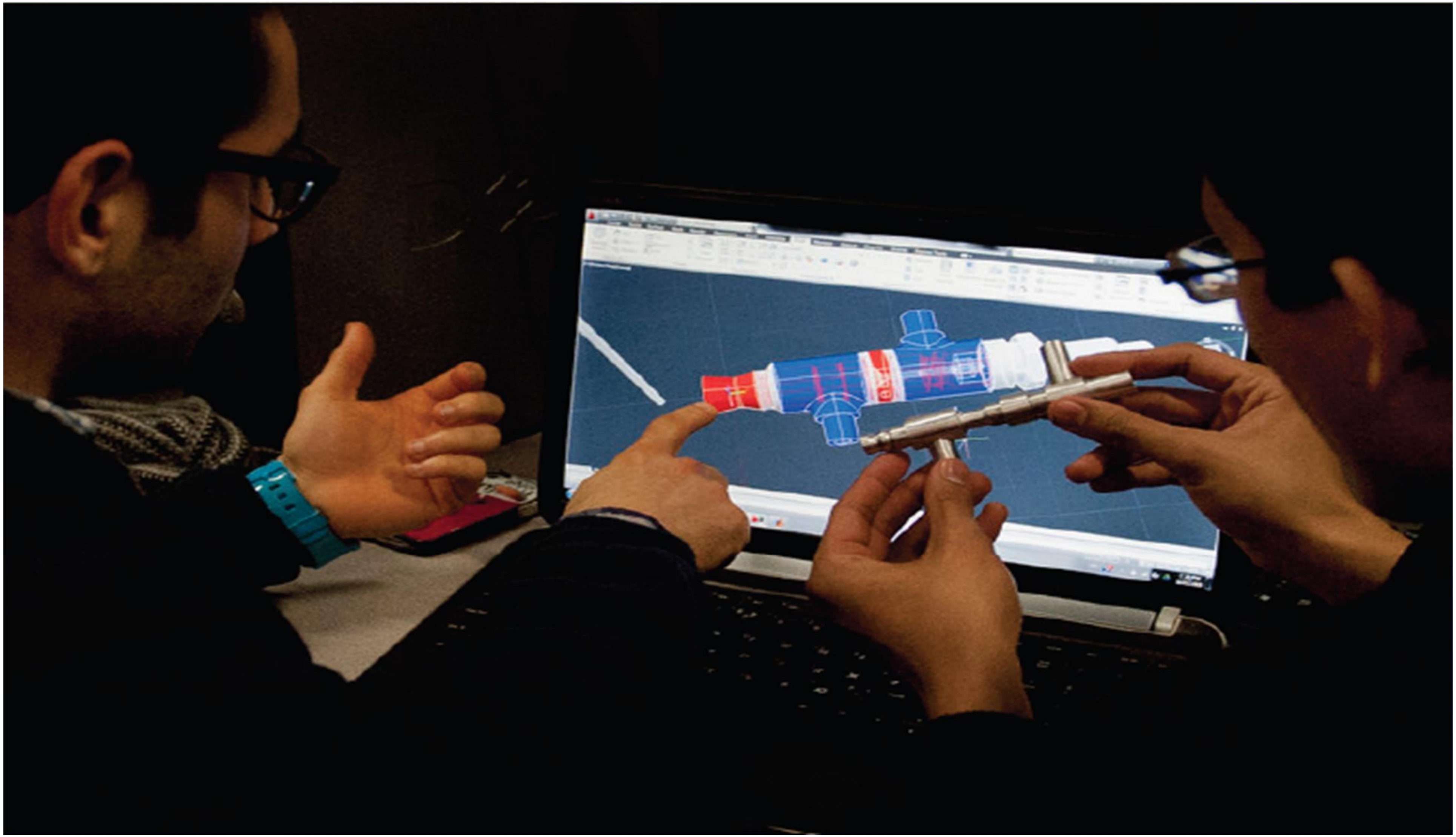
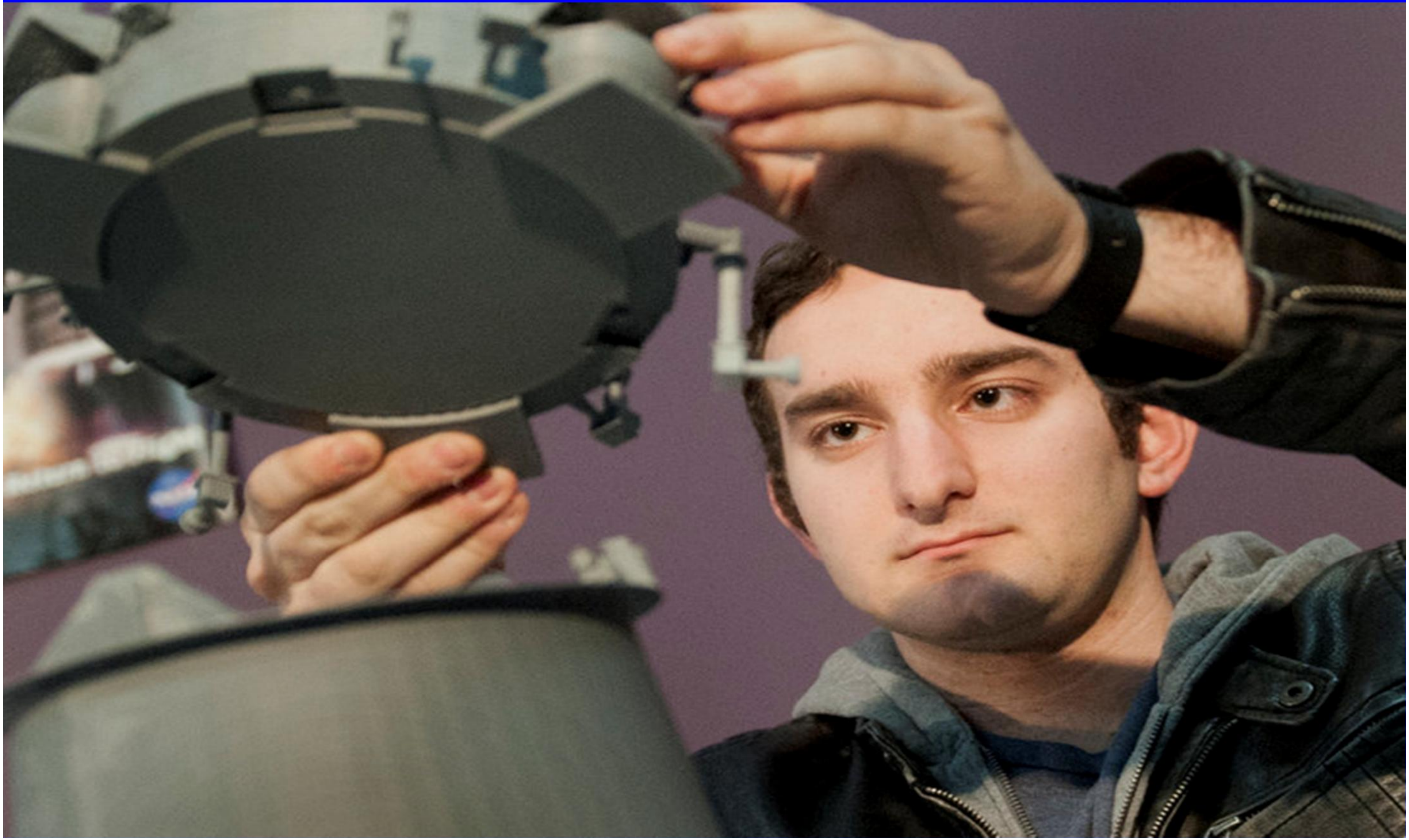
Lunar Lion students

Lunar Lion Team examining rocket design

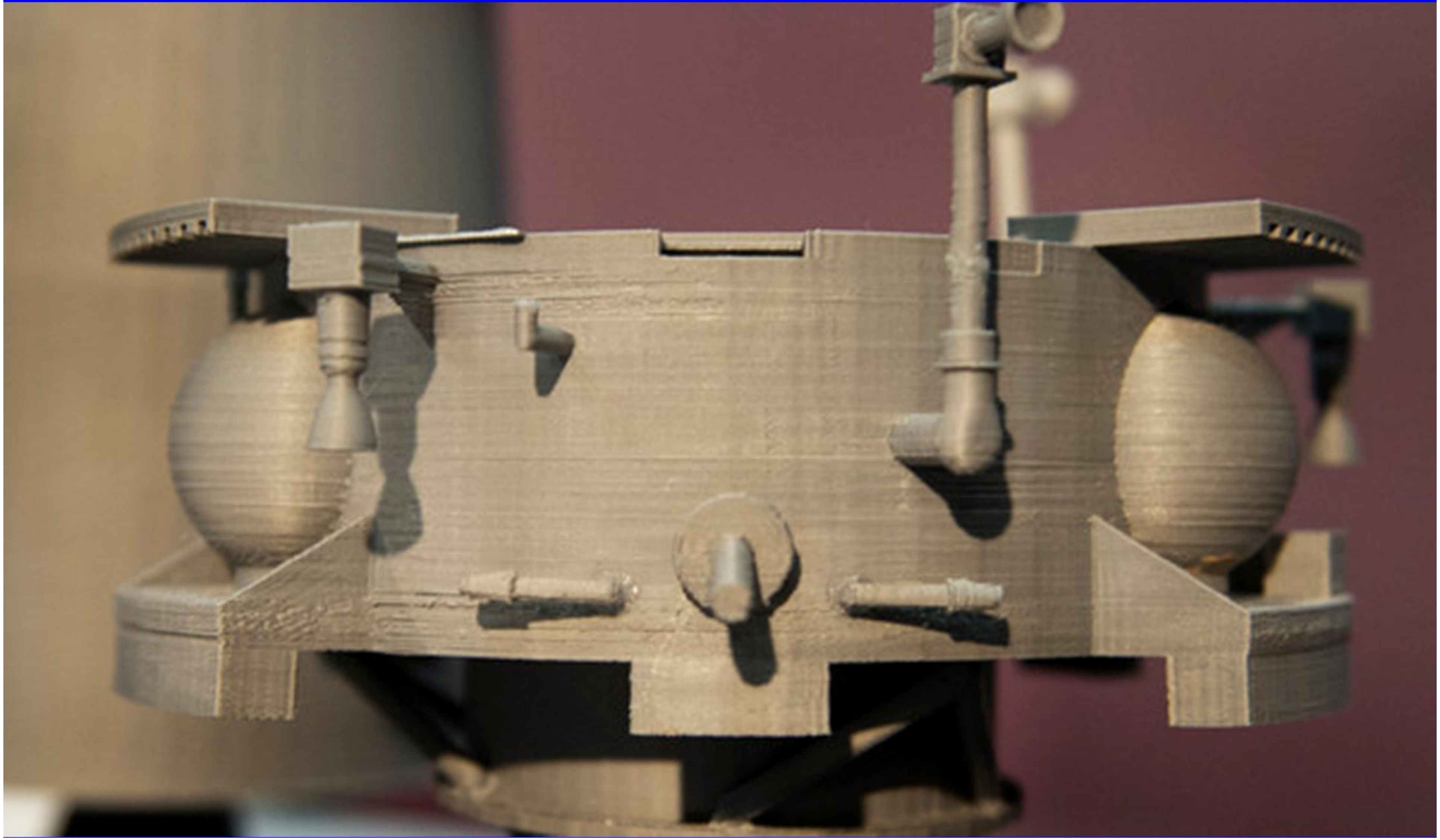


Lunar Lion 3-D model

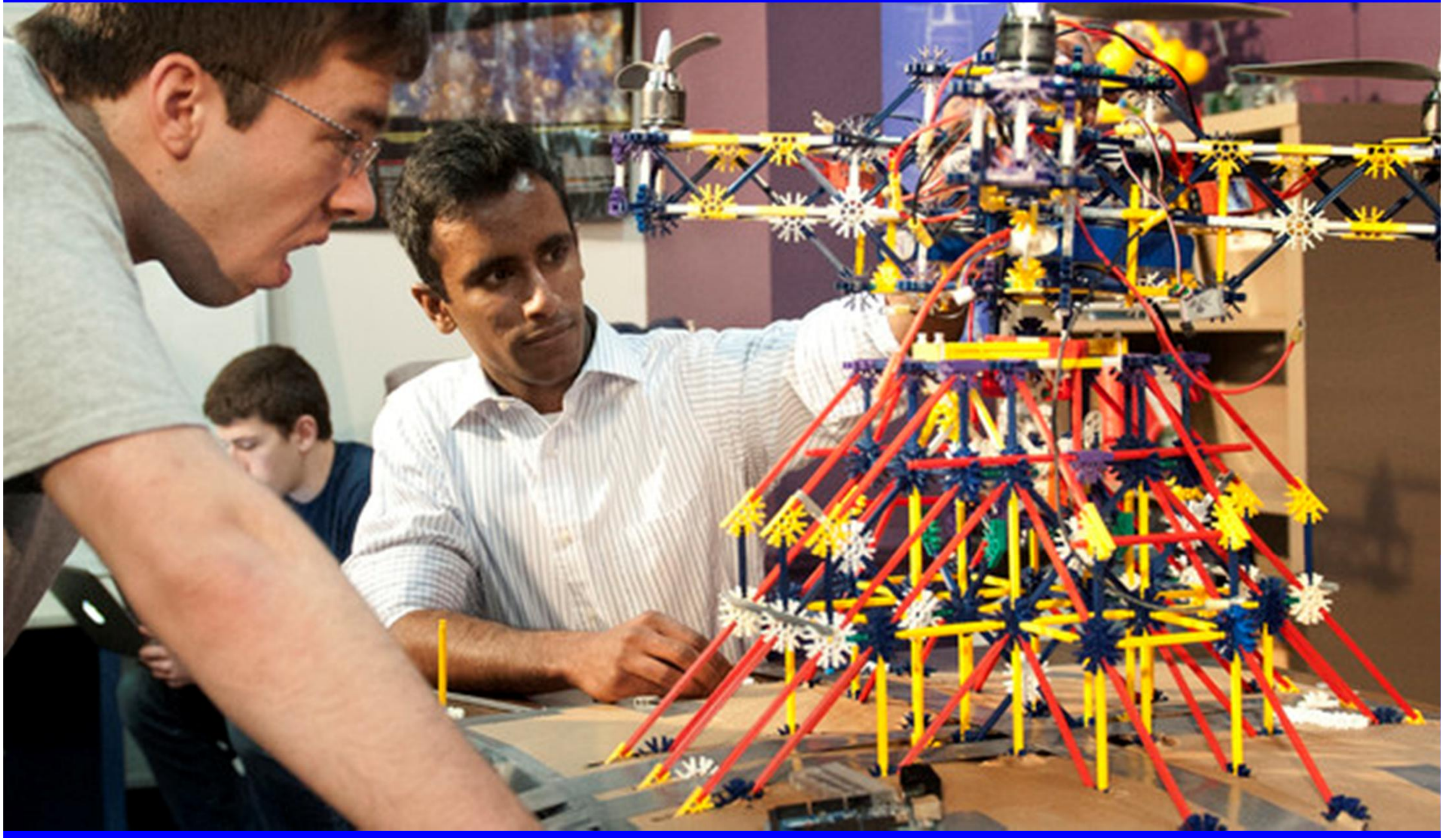
Assembling 3-D model of the Lunar Lion spacecraft



A 3-D printed model of the Lunar Lion spacecraft



Lunar Lion quadcopter test stand



Model of a rocket designed by Penn State’s Lunar Lion Team

Future Technologies

Raj Mittra

Electromagnetic Communication Lab

Penn State University

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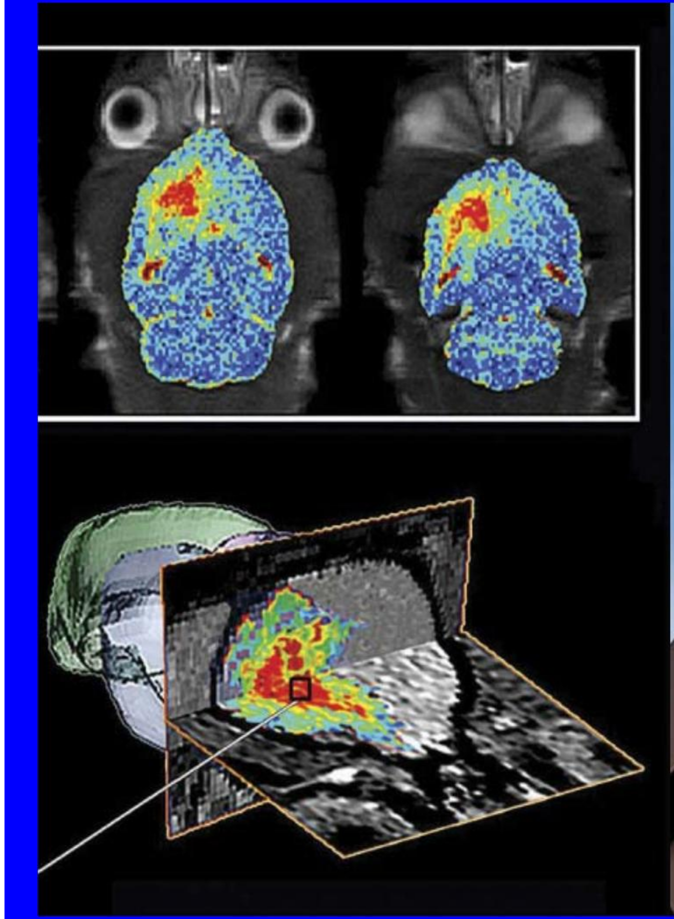
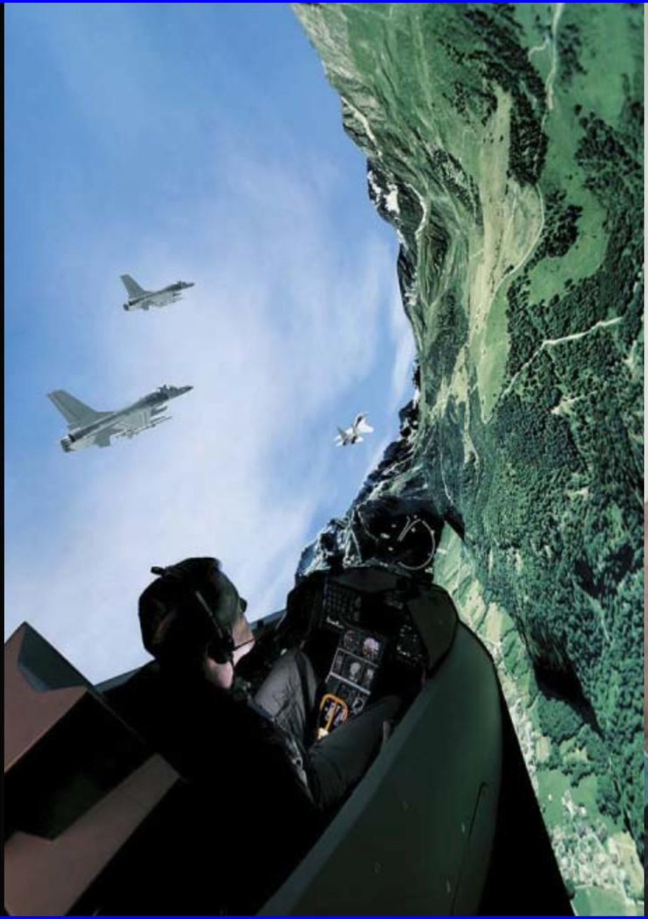
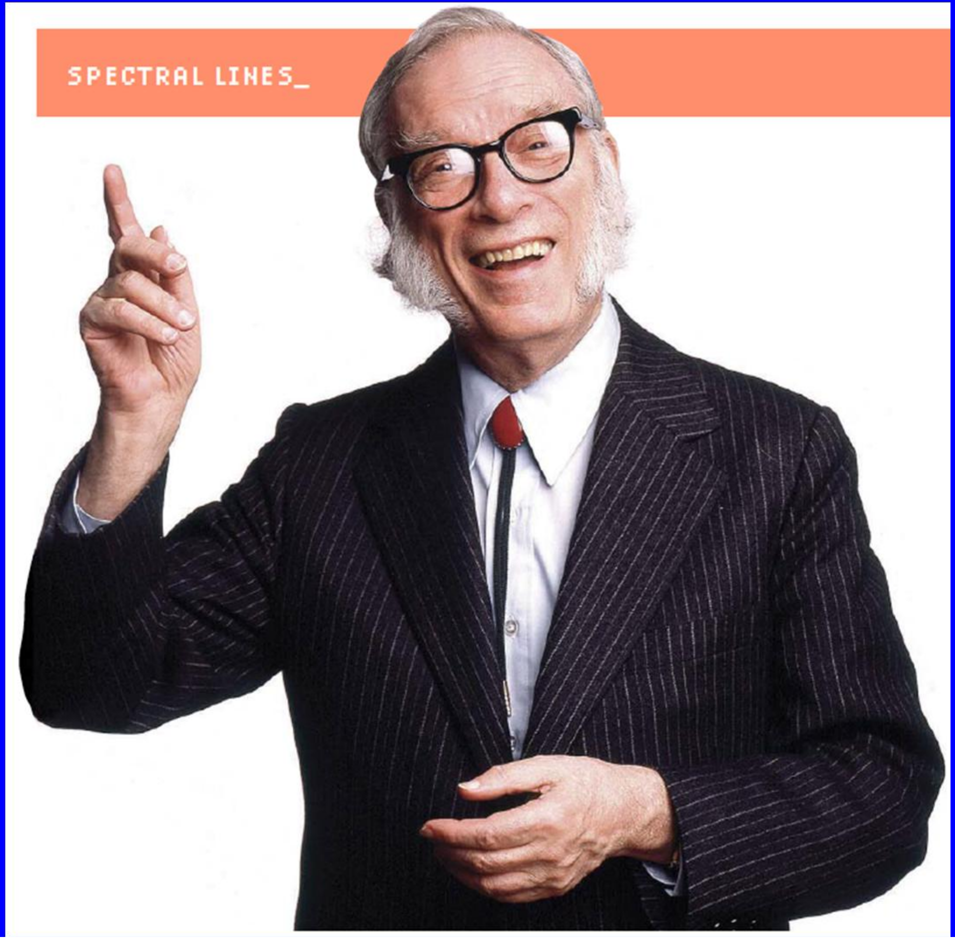
The future we deserve

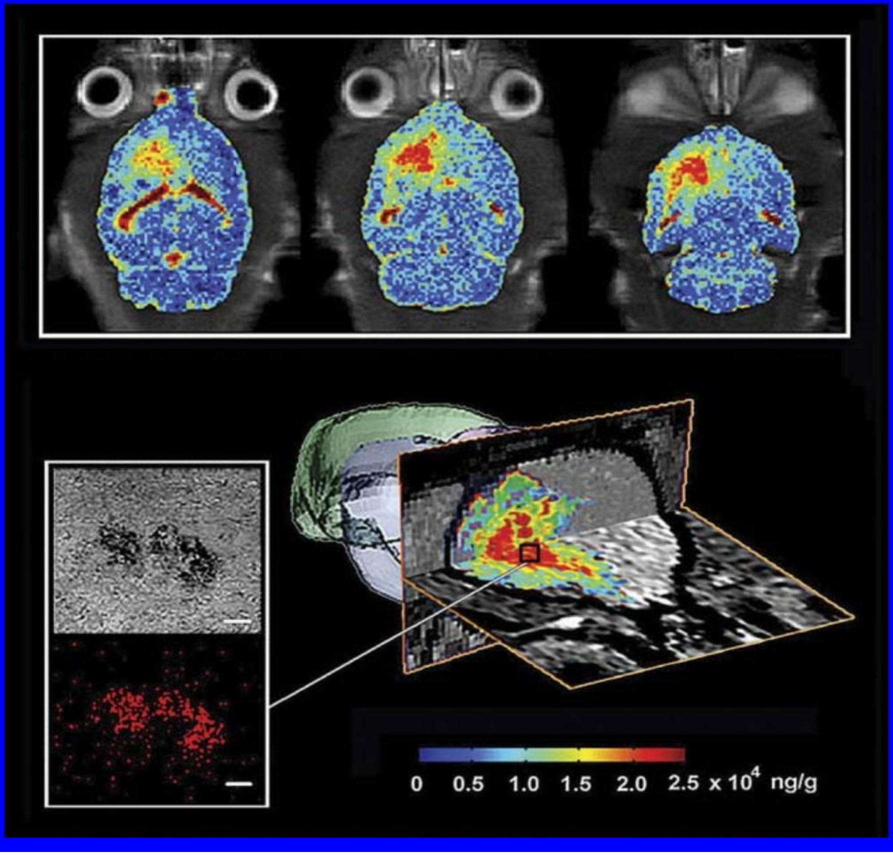
The Pitfalls of Prediction

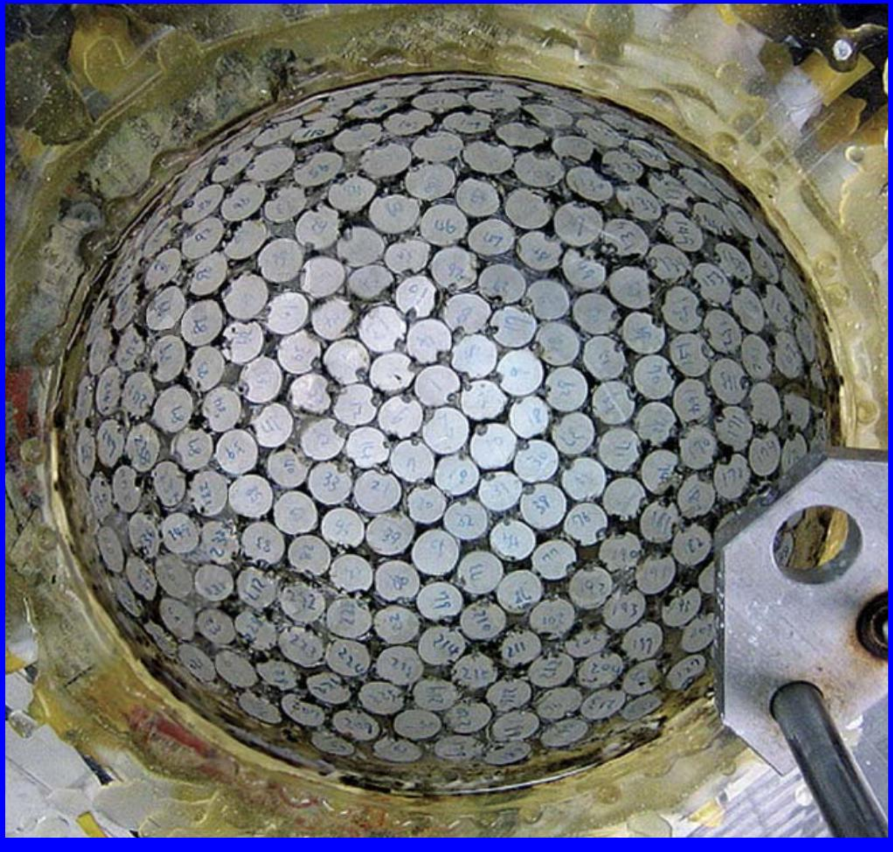
If you’re married, you may have concluded that marking an anniversary is an opportunity that must be handled with delicacy and imagination. And so it is for a magazine, too.



Window in the Brain

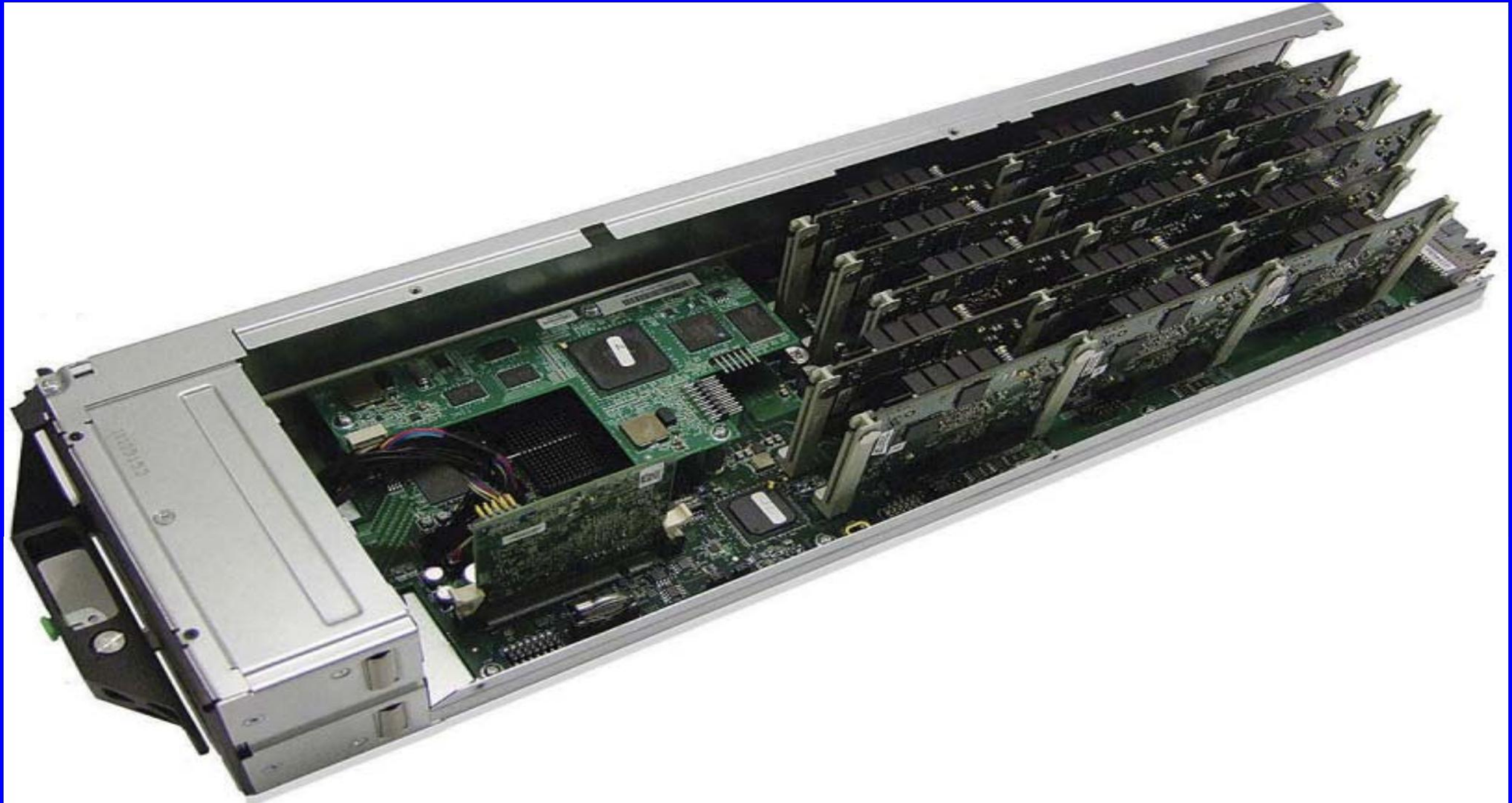
A 256-channel ultrasound array [right] has been tested on a pig. The array could electronically steer ultrasound energy to open the blood-brain barrier and allow a substance [above, in red] to enter the brain.



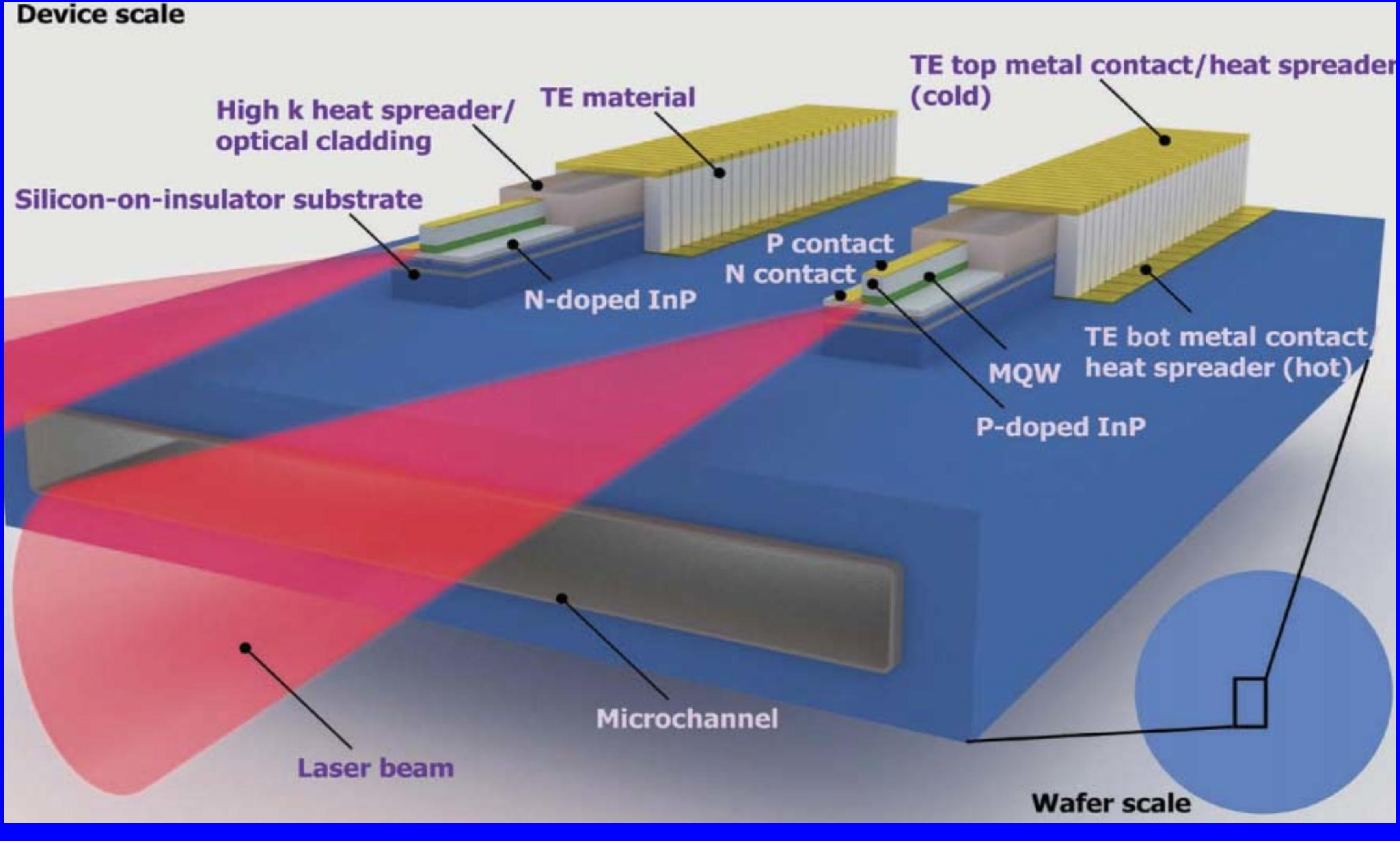


Europe wants a smartphone supercomputer

A consortium hopes to build exaflop supercomputers from mobile CPUs.

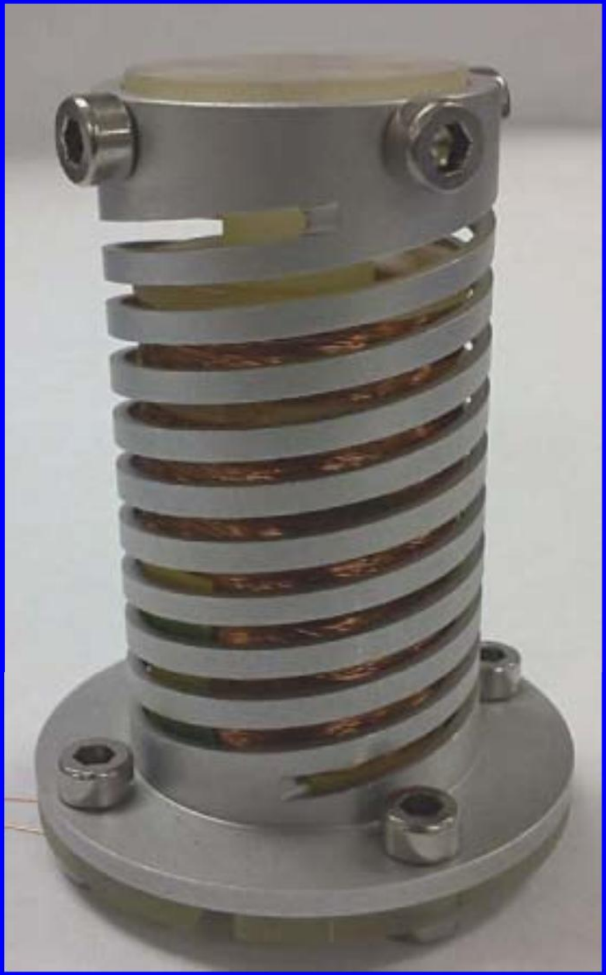


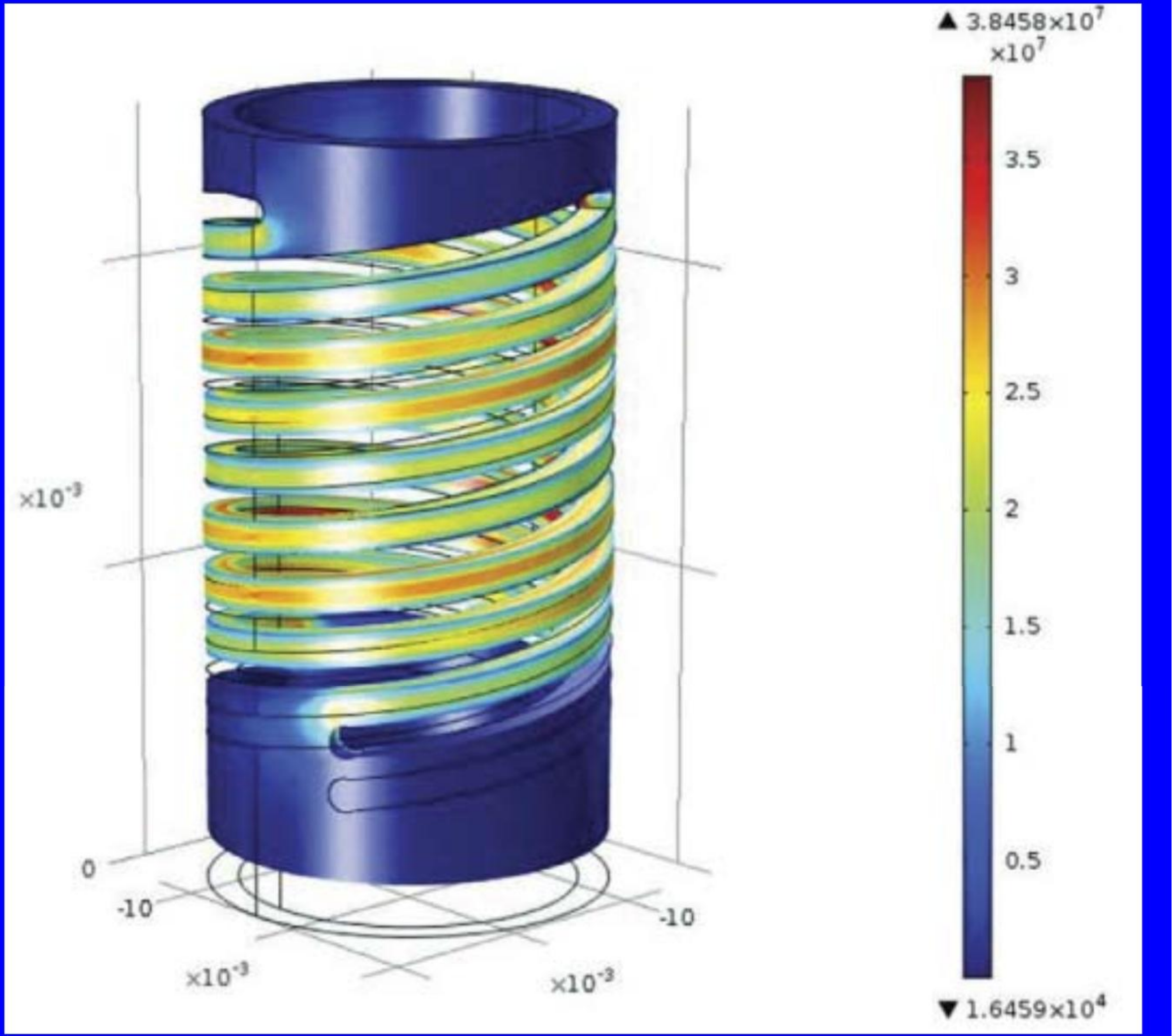
Schematic of the thermally integrated photonics system (TIPS) architecture, which includes microthermoelectric and microfluidic components.


Device scale
TE top metal contact/heat spreader
(cold)
TE material
High k heat spreader/
optical cladding
Silicon-on-insulator substrate
P contact
N contact
N-doped InP
TE bot metal contact/
heat spreader (hot)
MQW
P-doped InP
Microchannel
Laser beam
Wafer scale

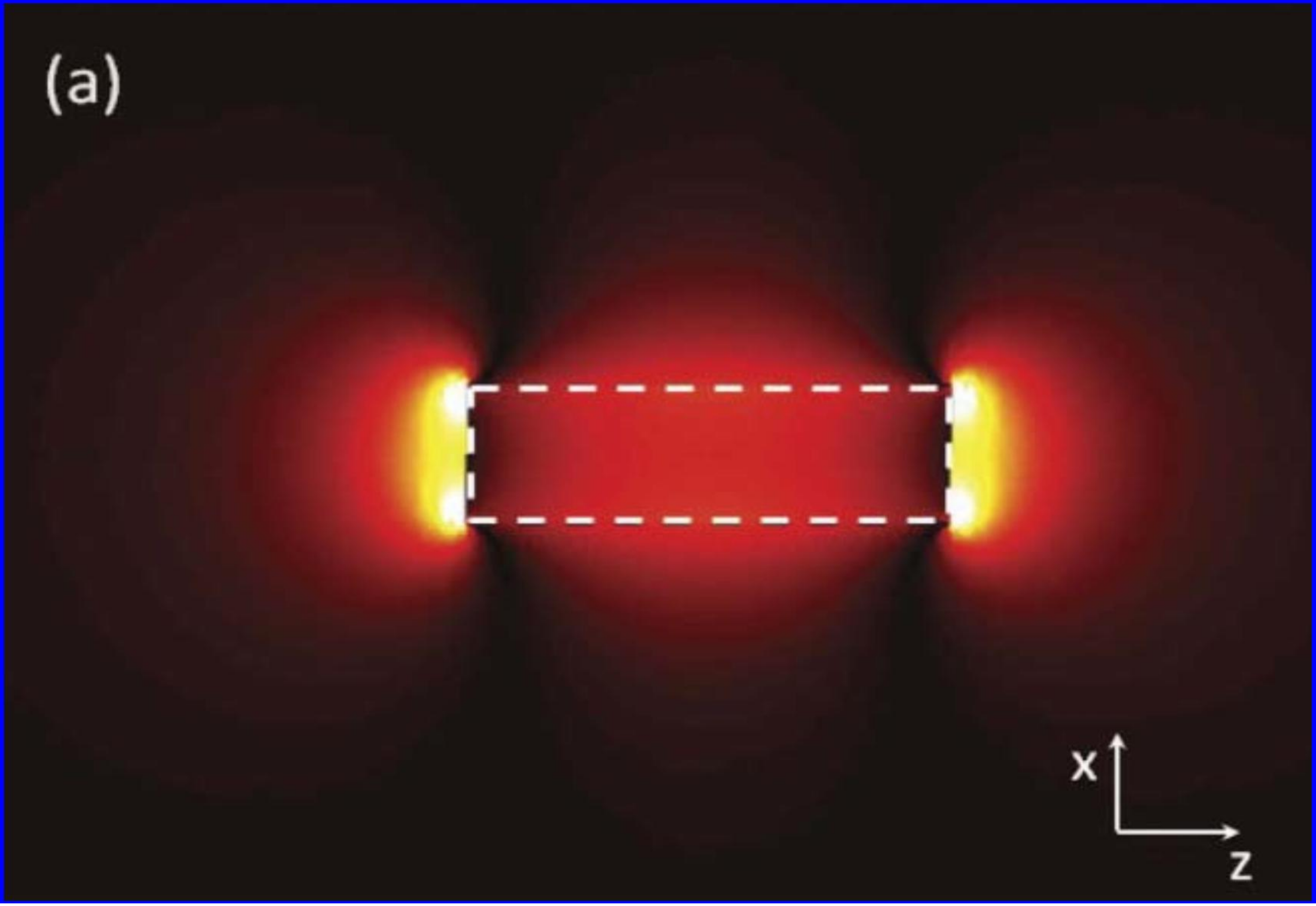
Left: Prototype of novel machined-spring energy harvester.

Right: Simulation of the energy harvester, showing von Mises stress.




▲ 3.8458×10^{7}
$\times10^{7}$
3.5
3
2.5
2
1.5
1
0.5
▼ 1.6459×10^{4}
$\times10^{-3}$
0
-10
-10
$\times10^{-3}$
$\times10^{-3}$

(a) Distribution of z-component of the electrical field |Ez| for the normalized quasinormal mode of a cylindrical gold nanorod with a diameter of 30 nm and a length of 100 nm. The white dashed line represents the rod contour.



(b) Spontaneous decay rate of a cold molecule located on the rod axis at a 10 nm distance from the rod. (c) Attenuation cross section of the rod under illumination by a plane wave polarized along its axis. In (b) and (c), black circles are fully vectorial computational results obtained with COMSOL. Each point requires an independent calculation. Simulation results are in good agreement with the predictions of the analytical model represented by the solid red curves.

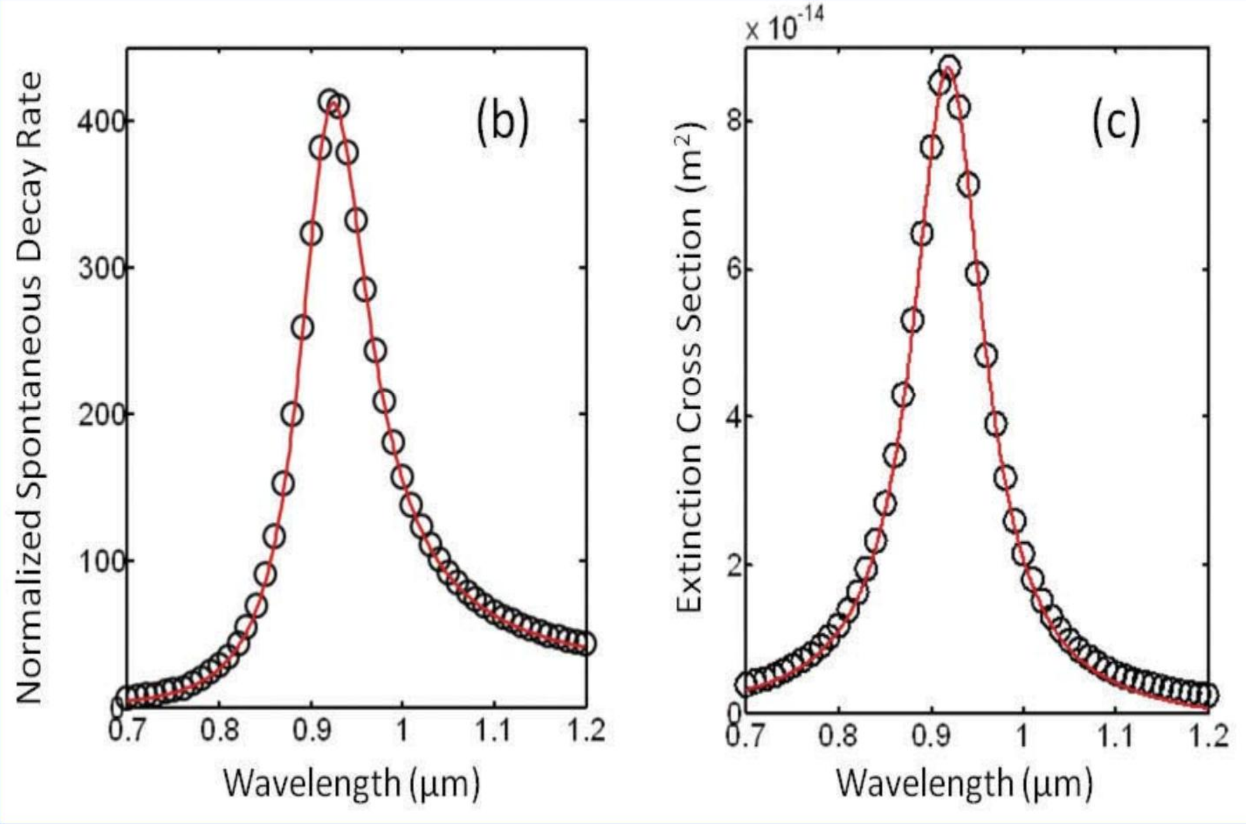
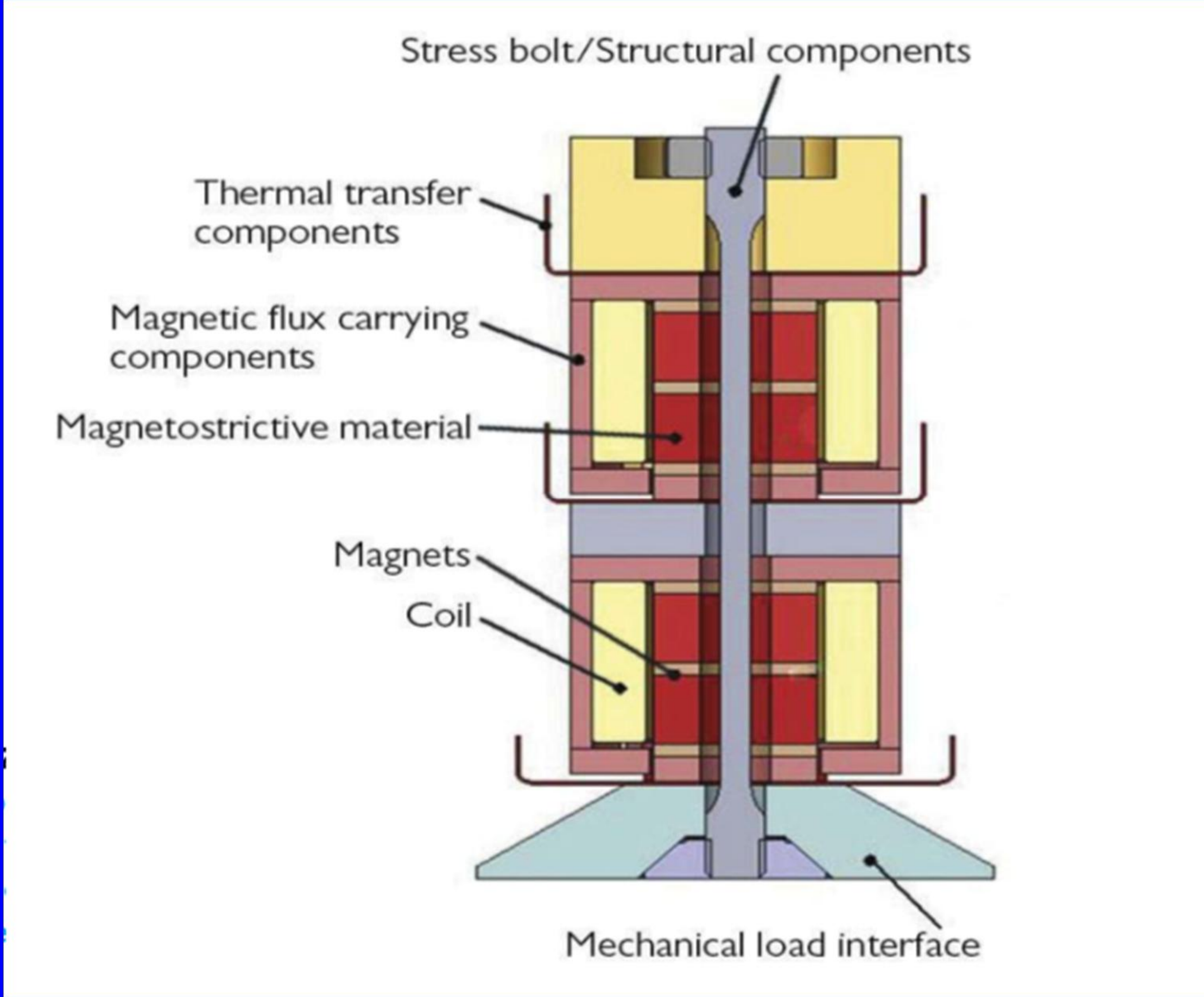
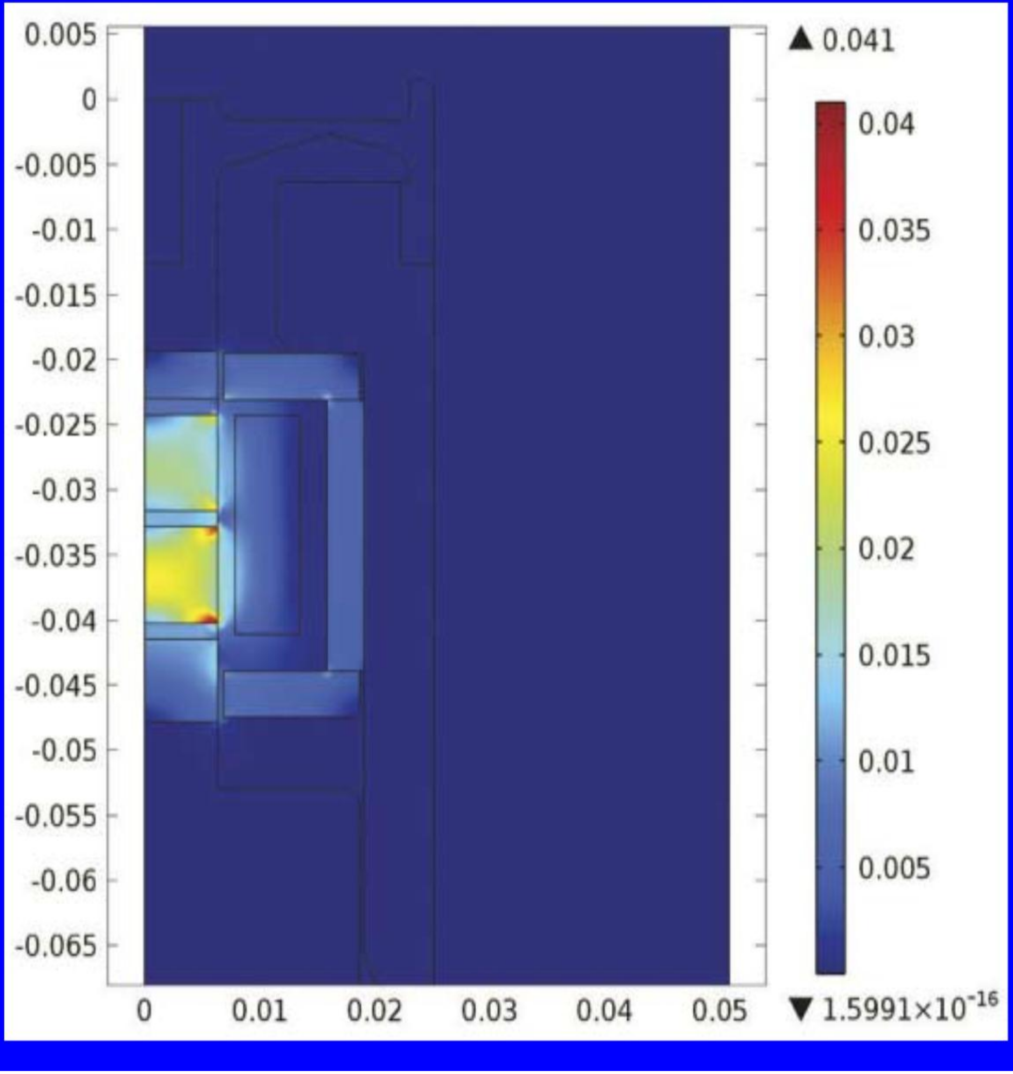
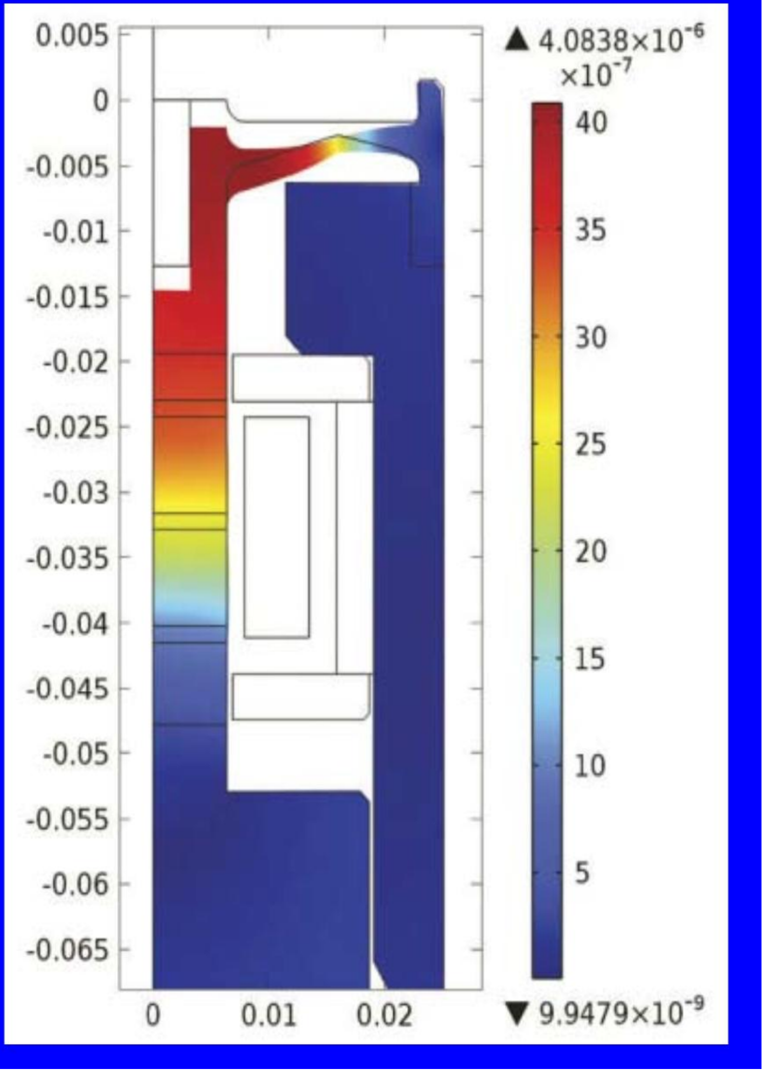


Diagram of a magnetostrictive transducer showing the magnetic and mechanical components of the device.


Stress bolt/Structural components
Thermal transfer components
Magnetic flux carrying components
Magnetostrictive material
Magnets
Coil
Mechanical load interface

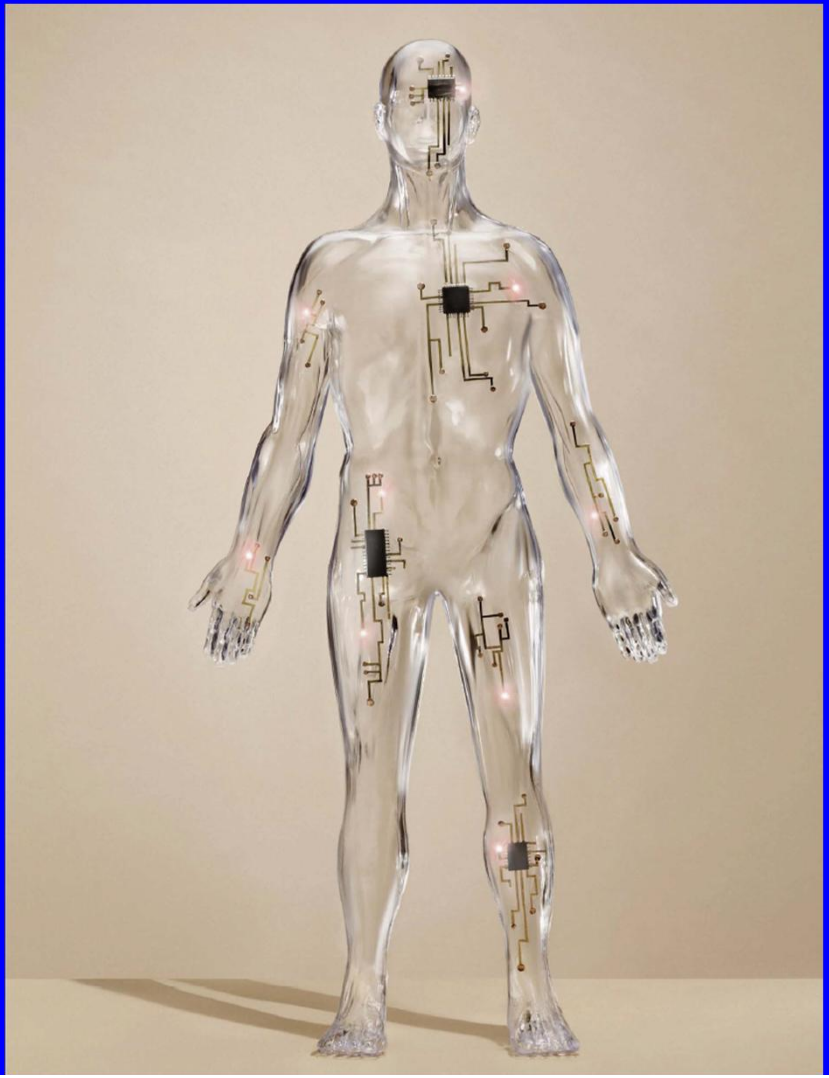
Magnetic fields generated from a 1-ampere input to the coil. Displacements are calculated using the maximum current input.





The end of disability

Prosthetics and neural interfaces will do away with biology’s failings

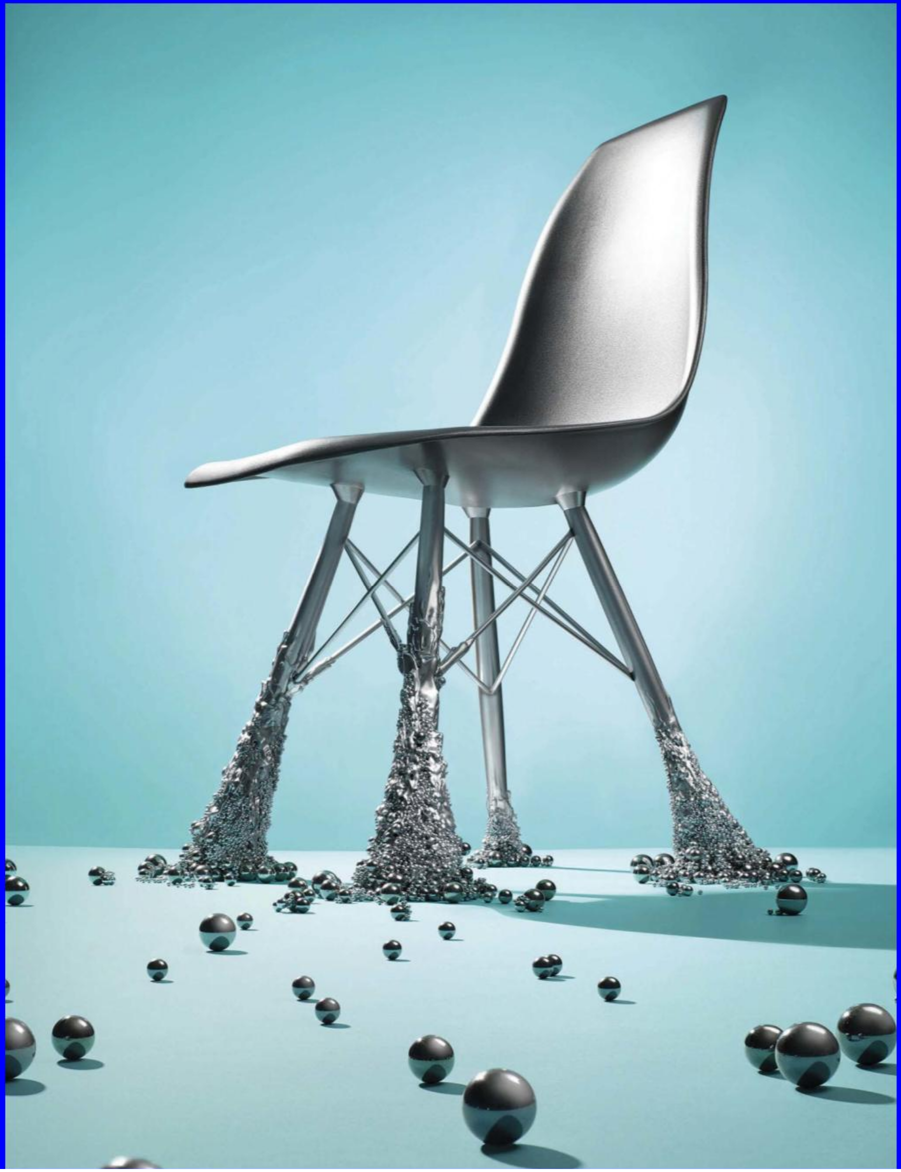


The end of disability Cont..

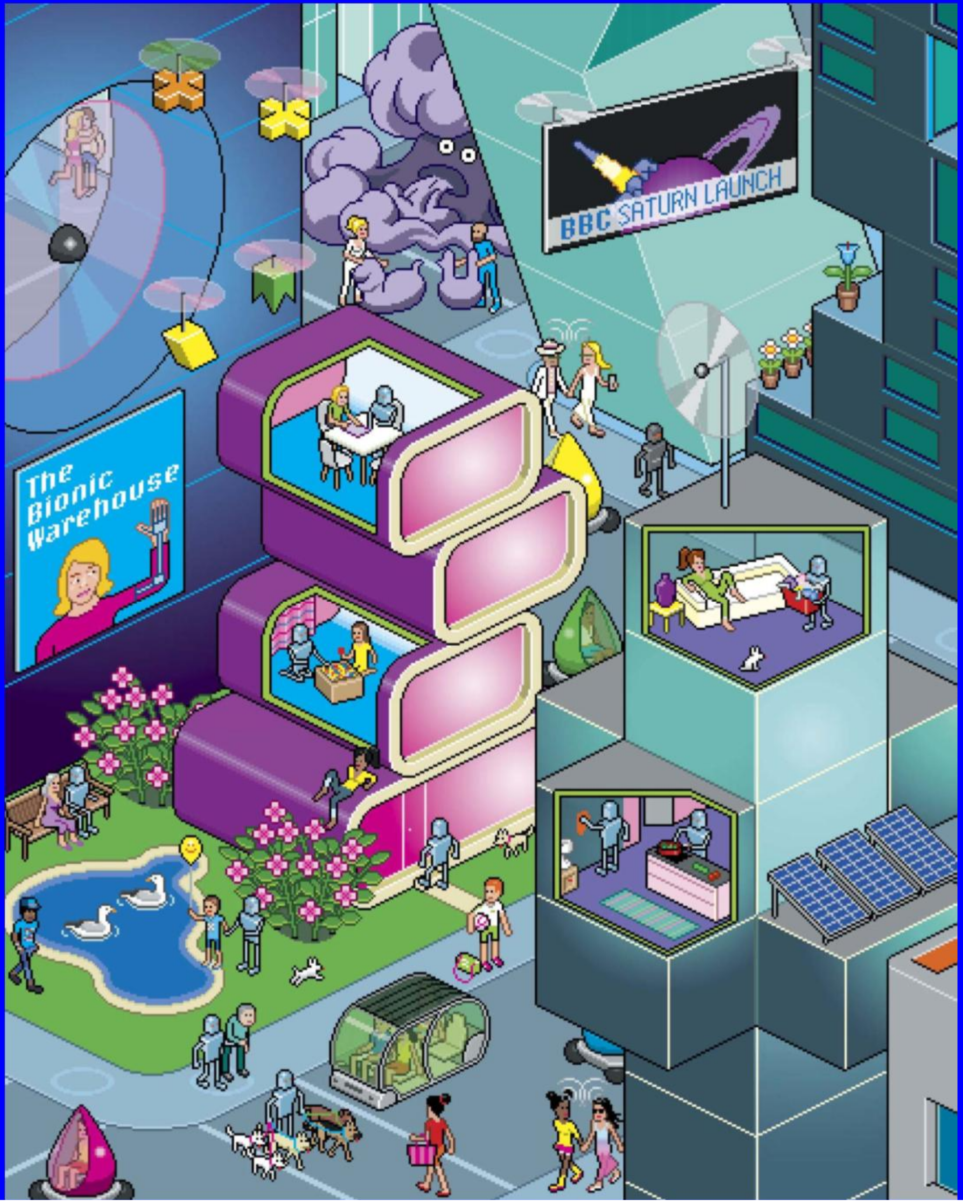
Prosthetics and neural interfaces will do away with biology’s failings

Infinitely malleable materials

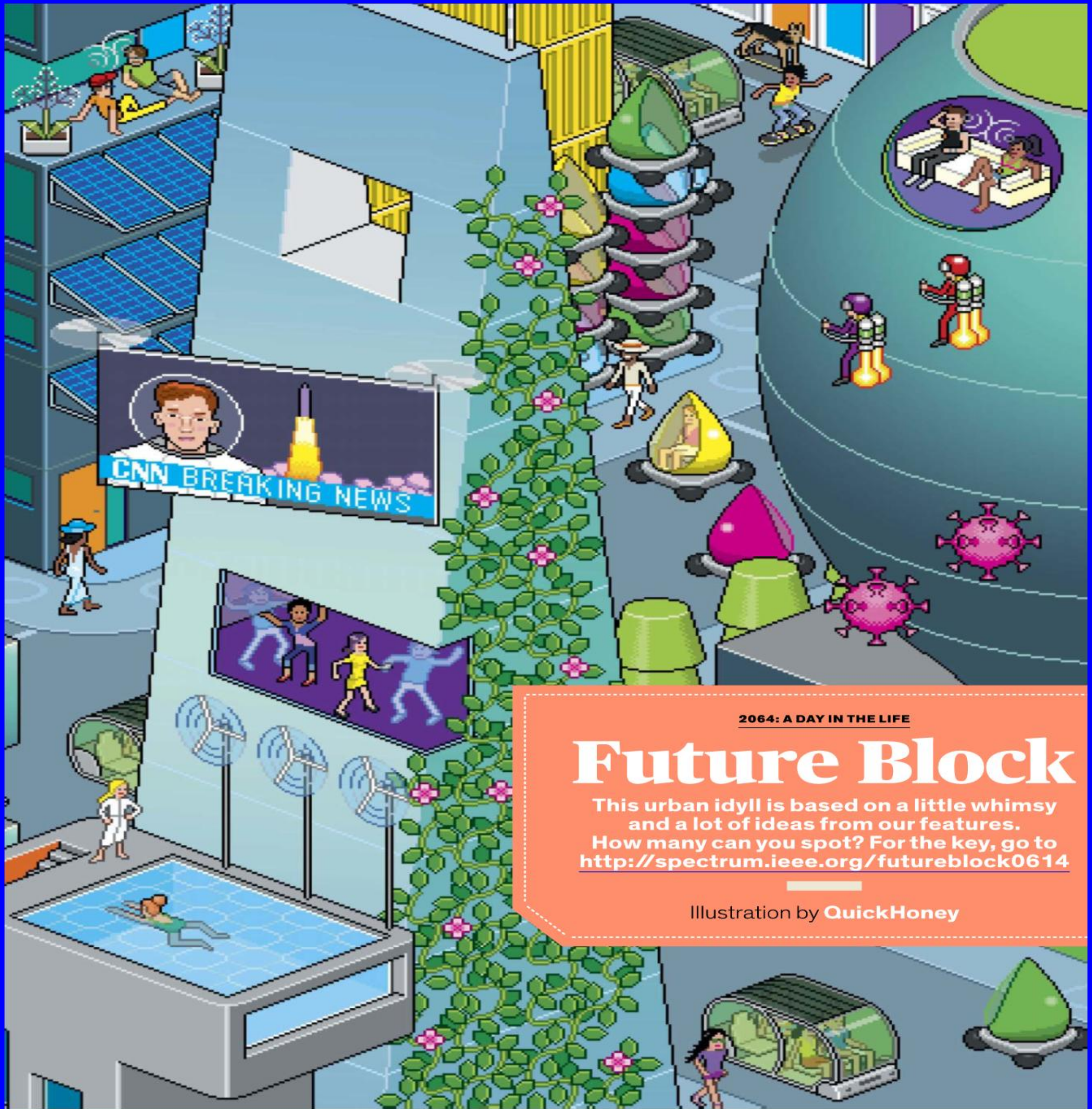
People will conjure objects as easily as we now play music or movies



2064_ A Day in the life


BBC SATURN LAUNCH
The Bionic Warehouse

2064_ A Day in the life Cont....



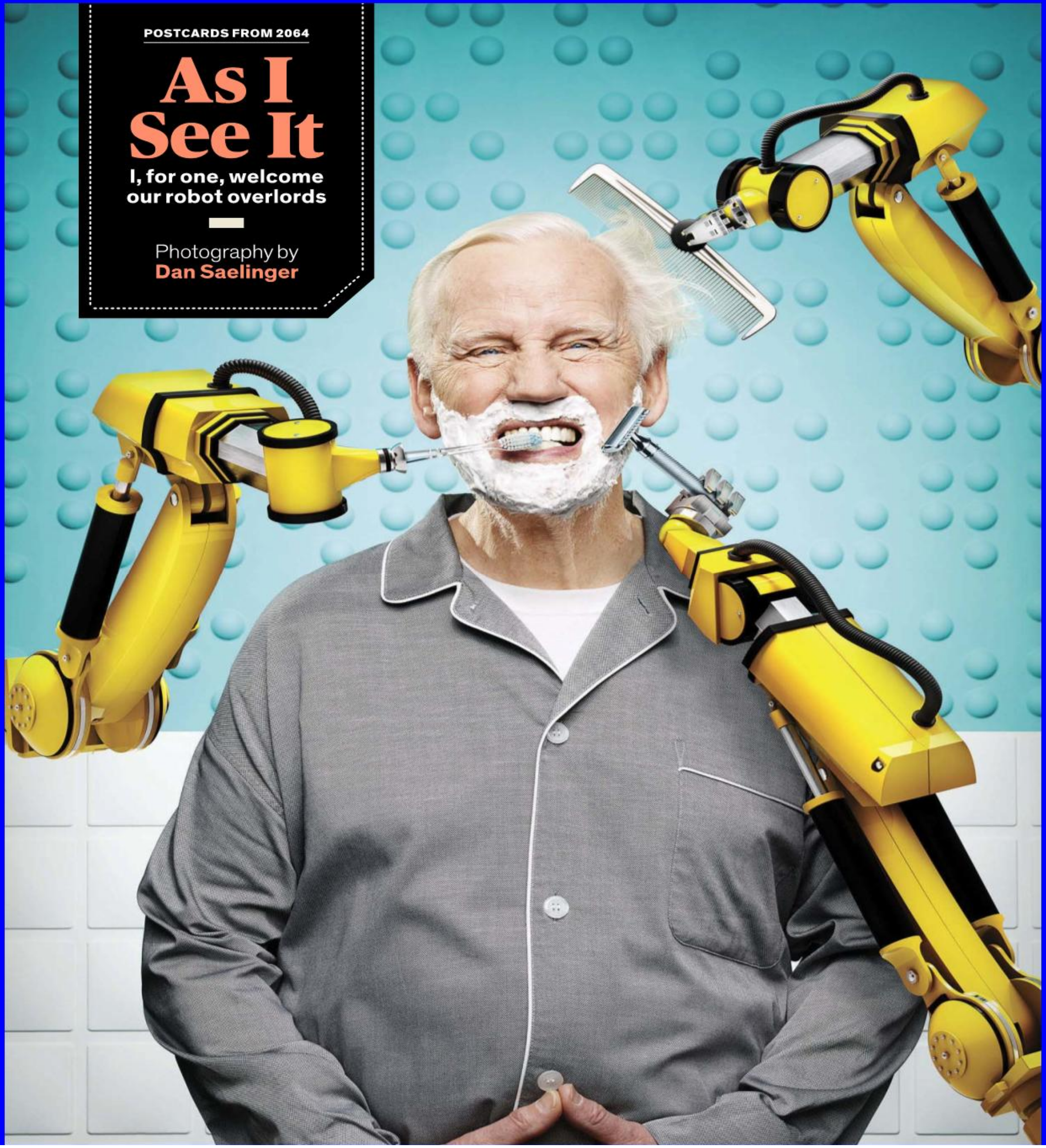
2064: A DAY IN THE LIFE

Future Block

This urban idyll is based on a little whimsy and a lot of ideas from our features. How many can you spot? For the key, go to http://spectrum.ieee.org/futureblock0614

Illustration by **QuickHoney**

As I See It__Robot overlords__



POSTCARDS FROM 2064

As I See It

I, for one, welcome our robot overlords

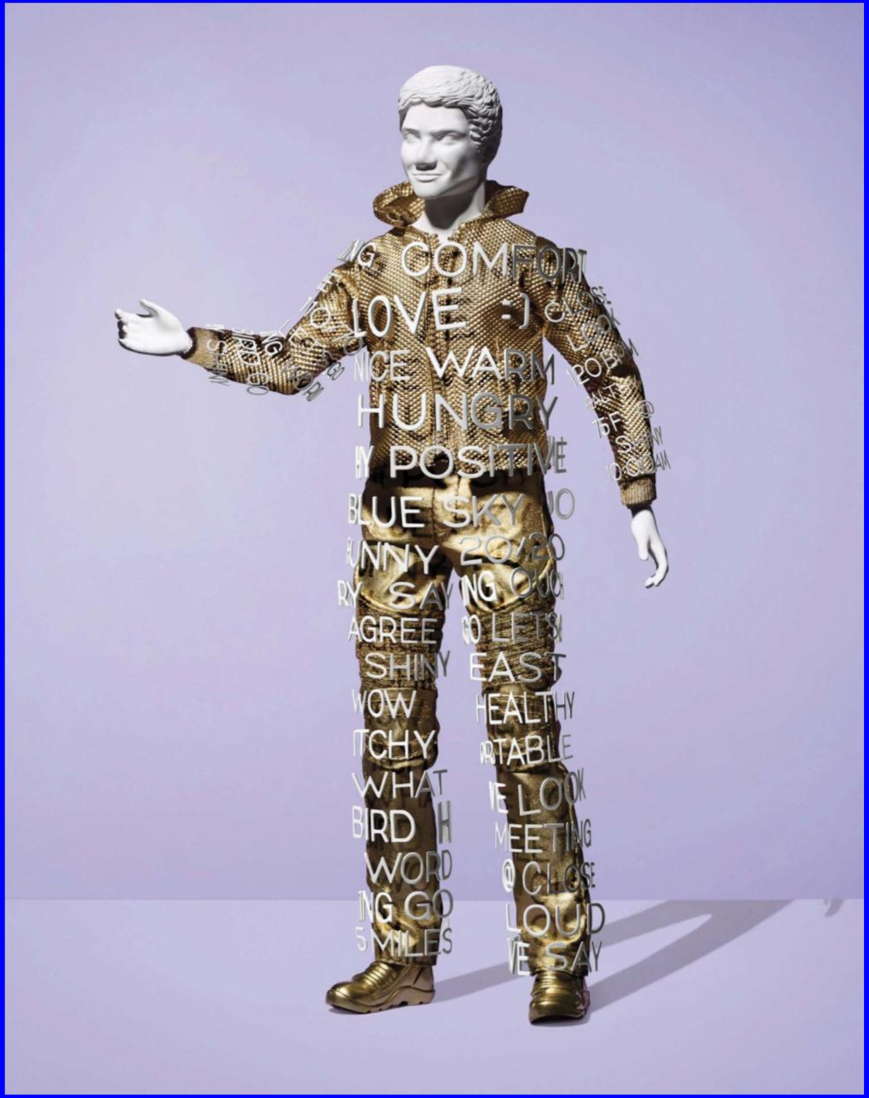
Photography by **Dan Saelinger**

When 99% Safe Isn’t Safe Enough

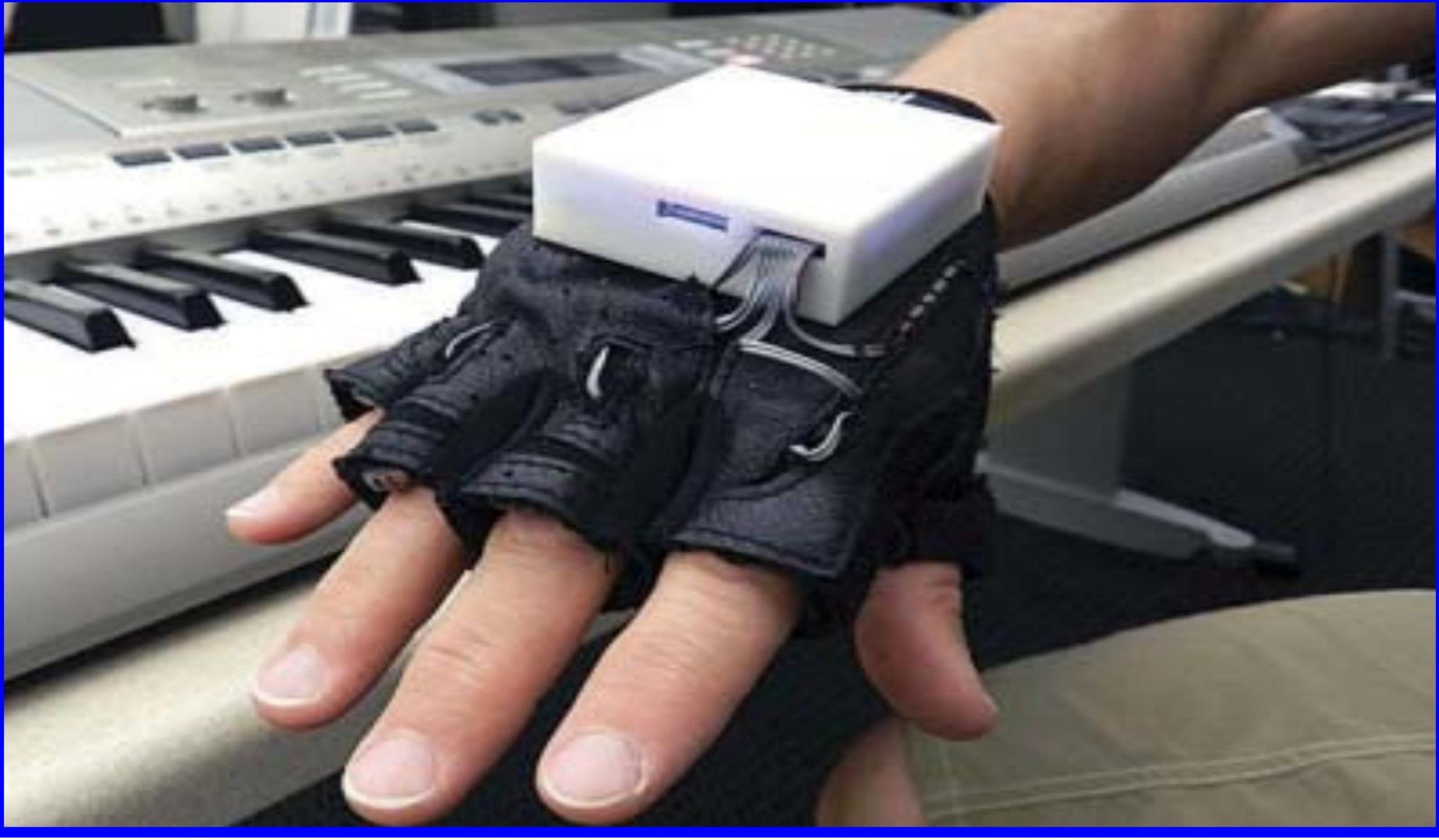
The dangers of autonomous-drive technology arise just as it approaches perfection

Beyond words

Wearable computers will let us share thoughts and sensations

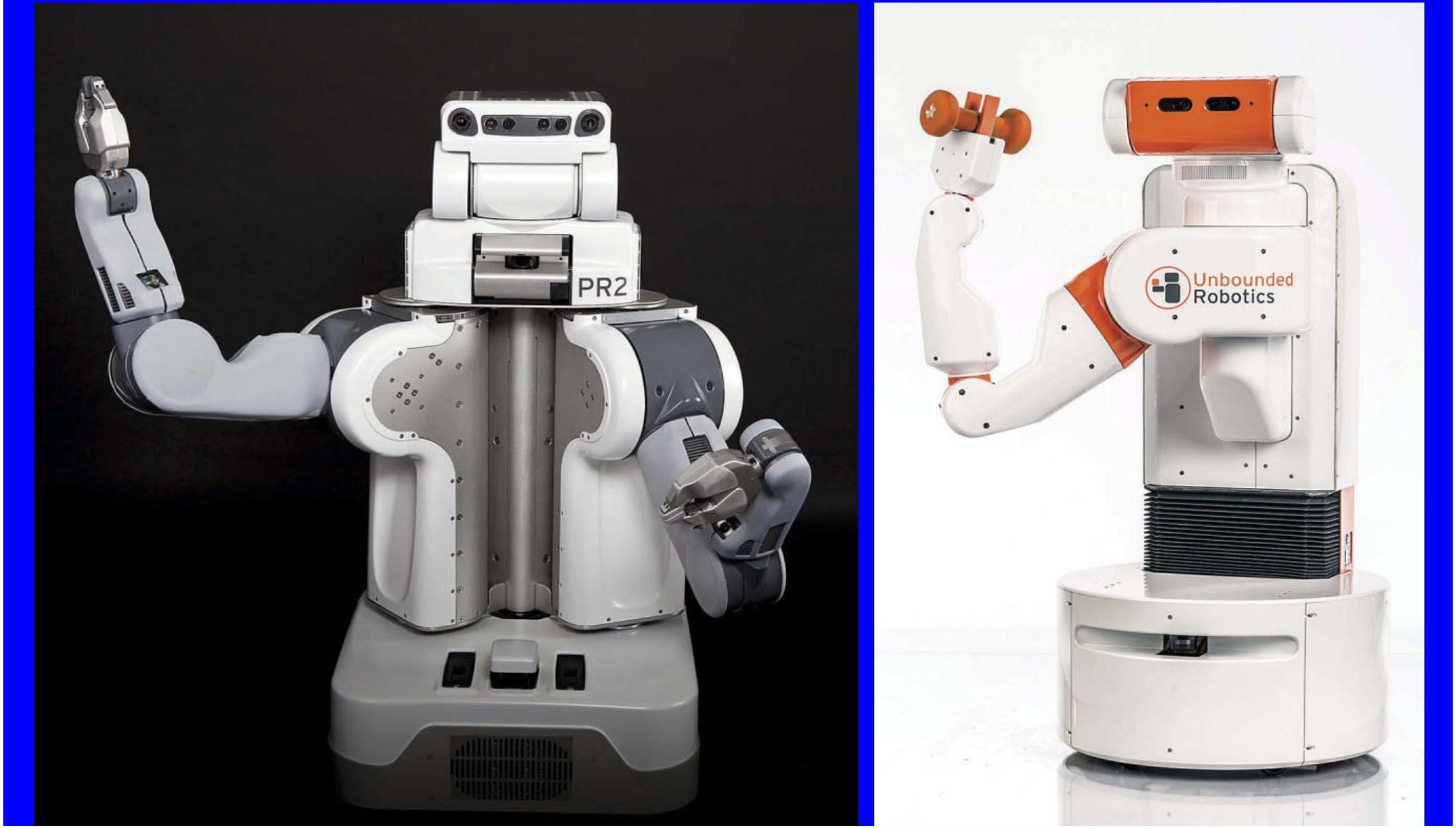

COMFORT
LOVE
WARM
HUNGRY
POSITIVE
BLUE SKY
AGREE
SHINY
EAST
WOW
HEALTHY
ITCHY
WHAT
BIRD
MEETING
WORD
LOUD
5 MILES

THE GLOVE LOOKS hum- drum, like a garment you might pick up at a sporting- goods store. It’s made of soft black leather and fingerless, like a cyclist’s or weight lifter’s glove. The similarity is, how- ever, deceiving.

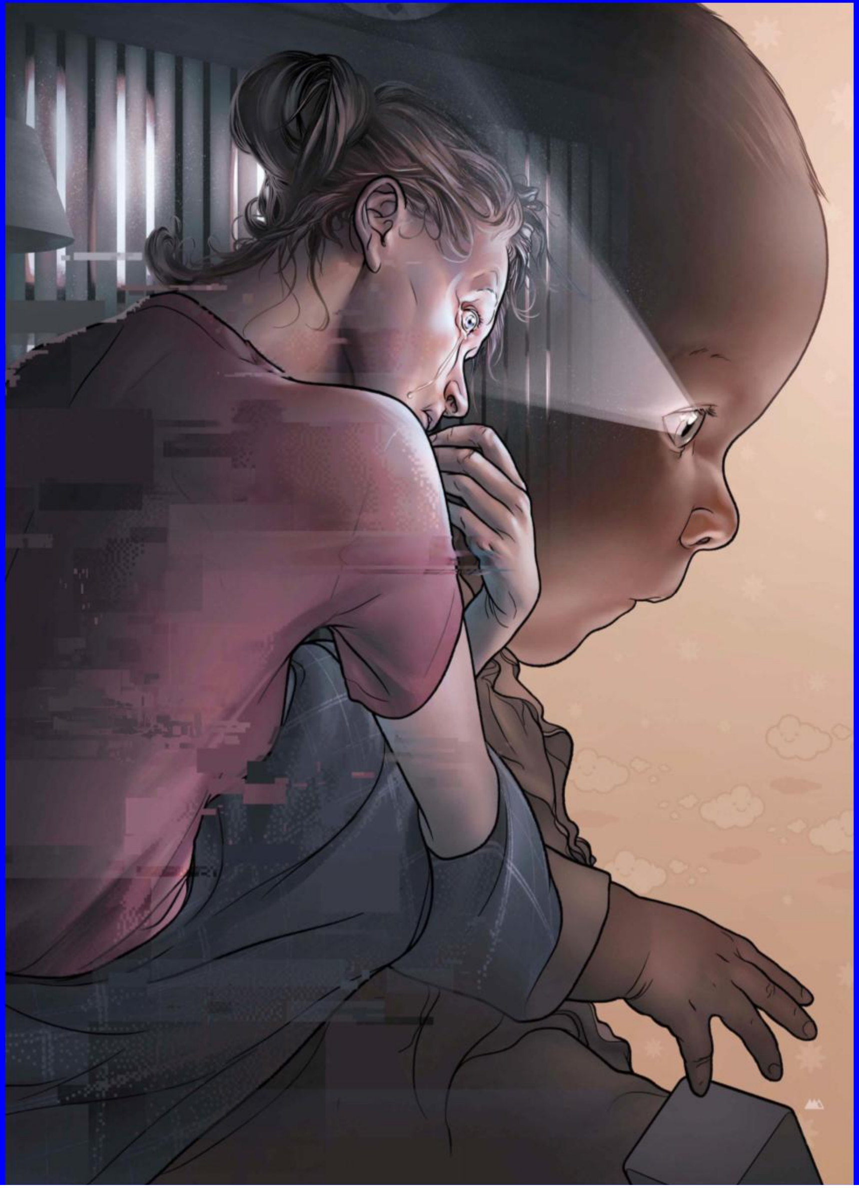


Robot evolution

PR2 [left] sold for US $400 000; one of its successors, UBR-1, is a bit less capable but costs about one-tenth as much.


PR2
Unbounded Robotics

Someone to watch over me

Every technology has unintended consequences